SEMANTIC-DRIVEN KNOWLEDGE-ENABLED COGNITIVE DECISION SUPPORT SYSTEM

Tasneem Memon

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CERTIFICATE OF AUTHORSHIP/ORIGINALITY

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Signature of Candidate

To my parents...

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Abstract

The importance of knowledge and cognition in business intelligence and decision support systems (DSS) is indisputable. However two major issues, a) *biases* in cognition, and b) *knowledge integration overhead* in knowledge warehousing, hinder their optimum utility in such systems. We address the issue of *biases* by proposing *semantic de-biased associations (SDA) model*, which is an improvement over the conventional causal map representation of mental models. SDA model incorporates *semantics* and *contextual information* to implement automated de-biasing by employing de-biasing techniques and algorithm into the inherent process of mental model elicitation, storage and retrieval. An elicitation process customised for SDA-based representation was also proposed namely *SDA articulation and elicitation cycle*. SDA model automates the process of mental model validation and integration, so as to prevent any espoused theories to be stored in the system. It also provides faster access to relevant knowledge, while creating a *knowledge cycle* between user and the system, which provides learning and knowledge growth opportunities to the system users, promoting organizational learning.

The issue of *knowledge integration overhead* is dealt with by proposing a unified, standard storage structure for knowledge warehousing in *subject-oriented semantic knowledge warehouse (SSKW)*. The unified storage structure is achieved through categorising knowledge on syntactic level, and creating universal templates of these categories. In addition, the rules of how they can be connected together are outlined. The categories of knowledge, formalised, are *object, process,* and *event*. The connections between them are implemented through *semantic relationships*. The SSKW provides a domain-independent knowledge warehousing architecture to store knowledge in a subject-oriented, semantic, integrated, systematic and meaningful manner. It incorporates object-oriented, semantic, and human-centric approaches to facilitate an intuitive and efficient communication. It prevents *loss of knowledge*, improves precision of output, and ensures efficient delivery of knowledge when required.

The SDA model and SSKW are integrated together in this research to form a human-centric DSS, *semantic-driven knowledge-enabled cognitive decision support system (SCDSS)*. SCDSS accumulates knowledge of many decision makers over time, thus if a decision maker leaves the organisation, his/her knowledge is retained through this system. Moreover, it automates the dissemination of knowledge across the organisation. Two evaluations were conducted to measure the performance of SCDSS against selected criteria. The results of the evaluations show that SCDSS successfully mitigates *availability, framing, contextual* and *group* biases, and generates new knowl-

edge during decision making process. The results also demonstrate the effectiveness of SCDSS in *knowledge sharing and enhancement*, *efficiency in producing output*; and the *relevance of knowledge* in the output.

The system can be accessed at `http://tasneememon.com/SCDSS/index.php`.

Keywords: Decision support systems, cognitive decision support, cognitive biases, knowledge warehousing, semantic knowledge representation.

Contents

Publications

1. Memon, T., Lu, J., Hussain, F.: ***Semantic de-biased associations (SDA) model to improve ill-structured decision support***. In Huang, T., Zeng, Z., Li, C., Leung, C., eds.: Neural Information Processing. Volume 7664 of Lecture Notes in Computer Science. Springer Berlin Heidelberg (2012) pp.483-490.

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6. Memon, T., Lu, J. Hussain, F.: *Subject-oriented Semantic Knowledge Warehouse Platform for Knowledge-enabled Business Intelligence*. To be submitted to *IEEE Transactions on Knowledge and Data Engineering*, a tier A journal.

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